ADMINISTRATIVE REPORT

Effects of Cabin Upsets on Adsorption Columns for Air Revitalization

Fellowship for W. Scot Appel

National Aeronautics and Space Administration

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Project Summary

The National Aeronautics and Space Administration (NASA) utilizes adsorption technology as part of contaminant removal systems designed for long term missions. A variety of trace contaminants can be effectively removed from gas streams by adsorption onto activated carbon. An activated carbon adsorption column meets NASA's requirements of a lightweight and efficient means of controlling trace contaminant levels aboard spacecraft and space stations. The activated carbon bed is part of the Trace Contaminant Control System (TCCS) which is utilized to purify the cabin atmosphere.

TCCS designs oversize the adsorption columns to account for irregular fluctuations in cabin atmospheric conditions. Variations in the cabin atmosphere include changes in contaminant concentrations, temperature, and relative humidity. Excessively large deviations from typical conditions can result from unusual crew activity, equipment malfunctions, or even fires.

The research carried out under this award focussed in detail on the effects of cabin upsets on the performance of activated carbon adsorption columns. Both experiments and modeling were performed with an emphasis on the roll of a change in relative humidity on adsorption of trace contaminants. A flow through fixed-bed apparatus was constructed at the NASA Ames Research Center, and experiments were performed there by W. Scot Appel under the direction of Dr. John E. Finn. Modeling work was performed at the University of Virginia and at Vanderbilt University by W. Scot Appel under the direction of M. Douglas LeVan. All three participants collaborated in all of the various phases of the research.

The most comprehensive document describing the research is the Ph.D. dissertation of W. Scot Appel. Results have been published in several papers and presented in talks at technical conferences.

All documents have been transmitted to Dr. John E. Finn.

Dissertation

Appel, W. S., "Adsorption Equilibrium and Fixed-Bed Dynamics for Organic Compounds and Water Vapor on Activated Carbon," Ph.D. Dissertation, University of Virginia, August 1998.

Publications

Appel, W. S., LeVan, M. D., and Finn, J. E., "Effects of Humidity Fluctuations on Adsorption Columns Used for Air Purification in Closed Environments," *SAE Technical Paper Series*, #961358 (ISSN 0148-7191), 1996, 5 pp.

Appel, W. S., LeVan, M. D., and Finn, J. E., "Nonideal Adsorption Equilibria Described by Pure Component Isotherms and Virial Mixture Coefficients," *Ind. Eng. Chem. Research*, **37**, 4774–4782 (1998).

LeVan, M. D., Appel, W. S., Finn, J. E., and Finn, C. K., "Novel Regenerable Incinerator Exhaust Purification and Trace Contaminant Control System Utilizing Humidity Swings," *SAE Technical Paper Series*, #981760 (ISSN 0148-7191), 1998, 11 pp.

Taqvi, S. M., Appel, W. S., and LeVan, M. D., "Coadsorption of Organic Compounds and Water Vapor on BPL Activated Carbon. 4. Methanol, Ethanol, Propanol, Butanol, and Modeling," *Ind. Eng. Chem. Research*, **38**, 240–250 (1999).

Presentations

Appel, W. S., LeVan, M. D., and Finn, J. E., "Effects of Humidity Fluctuations on Adsorption Columns Used for Air Purification in Closed Environments," 26th International Conference on Environmental Systems, Monterey, California, July 1996.

Appel, W. S., LeVan, M. D., and Finn, J. E., "Effects of Humidity on Activated Carbon Adsorption Columns used for Air Purification," Symposium on Fundamentals of Ad-

sorption and Ion Exchange, AIChE 1996 Annual Meeting, Chicago, Illinois, November 1996.

LeVan, M. D., Appel, W. S., Finn, J. E., and Finn, C. K., "Novel Regenerable Incinerator Exhaust Purification and Trace Contaminant Control System Utilizing Humidity Swings," 28th International Conference on Environmental Systems, Danvers, Massachusetts, July 1998.

Appel, W. S., LeVan, M. D., and Finn, J. E., "Nonideal Adsorption Equilibrium Described by Pure Component Isotherms and Virial Mixture Coefficients," Symposium on Fundamentals of Adsorption and Ion Exchange, AIChE 1998 Annual Meeting, Miami Beach, Florida, November 1998.